

What is claimed is:

- 2 1. An apparatus for performing a process on a substrate, comprising:
3 a conveyor to support the substrate along a work flow path;
4 a substrate transfer mechanism configured and arranged to remove the
5 substrate from and place another substrate on said conveyor; and
6 at least one processing island located along said flow path, each processing
7 island having a valve for introduction and extraction of the substrate into and out of
8 an interior thereof.
- 1 2. The apparatus of claim 1, wherein said processing island is an inspection station for
2 inspection of the substrate.
- 1 3. The apparatus of claim 1, wherein each processing island includes a load lock
2 chamber and a processing chamber.
- 1 4. The apparatus of claim 3, wherein said load lock chamber is a heating or cooling or
2 heating/cooling chamber.
- 1 5. The apparatus of claim 3, wherein said processing chamber includes one or more
2 chambers configured to perform at least one of a CVD process, a PECVD process, an
3 etching process, a cleaning process, a descumming process, a PVD process, a post-
4 anneal process, or a combination thereof.
- 1 6. The apparatus of claim 3, wherein each processing island includes two or three
2 processing chambers.
- 1 7. The apparatus of claim 1, wherein said conveyor includes a plurality of substrate
2 holding elements.

- 1 8. The apparatus of claim 1, further including at least one substrate stacker to hold
2 substrates prior to or after processing.
- 1 9. The apparatus of claim 1, wherein said substrate transfer mechanism includes an end
2 effector for supporting the substrate, a horizontal linear actuator for horizontally
3 translating the end effector, and a vertical linear actuator for vertically translating the
4 end effector.
- 1 10. The apparatus of claim 9, wherein the end effector is fork-shaped.
- 1 11. The apparatus of claim 9, wherein said substrate transfer mechanism further includes
2 a vertical rotary actuator for rotating the end effector about a vertical axis.
- 1 12. The apparatus of claim 1, wherein said substrate transfer mechanism is moveable,
2 from a position directly below the substrate on said conveyor when the substrate is in
3 a stopped position adjacent said processing island, to a position engaging the
4 substrate, and then to a final position wherein the substrate is positioned above the
5 conveyor.
- 1 13. The apparatus of claim 1, wherein each processing island includes an entry load lock
2 chamber, a processing chamber and an exit load lock chamber.
- 1 14. The apparatus of claim 13, wherein said entry load lock chamber is a heating chamber
2 and said exit load lock chamber is a cooling chamber.
- 1 15. An apparatus for performing a thin film process on a substrate, comprising:
2 a conveyor for supporting a substrate as it moves along a flow path;
3 a plurality of processing islands, each including:
4 an exterior,
5 an interior, and

6 at least one valve for exchange of the substrate between the exterior
7 and the interior; and
8 a substrate exchange apparatus configured and arranged to retrieve the
9 substrate from the conveyor, introduce the substrate into the interior of a selected
10 processing island, extract the substrate from the interior of the selected processing
11 island, and replace the substrate on the conveyor.

1 16. The apparatus of claim 15, wherein each one of said plurality of processing islands
2 includes:
3 a first load lock chamber having a first valve for introduction of the substrate
4 therein;
5 a processing chamber in communication with said first load lock chamber;
6 and
7 a second load lock chamber in communication with said processing chamber
8 and having a second valve for extraction of the substrate therefrom.

1 17. The apparatus of claim 16, wherein said first load lock chamber is a heating chamber
2 and said second load lock chamber is a cooling chamber.

1 18. The apparatus of claim 15, wherein the substrate exchange apparatus includes:
2 a first robot for retrieving the substrate from the conveyor and introducing the
3 substrate into the interior of the selected processing island; and
4 a second robot for extracting the substrate from the interior of the selected
5 processing island and positioning the substrate on the conveyor.

1 19. The apparatus of claim 15, wherein the substrate exchange apparatus includes:
2 a loader having an end effector for retrieving the substrate from the conveyor
3 and introducing the substrate into the interior of the selected processing island; and
4 an unloader having an end effector for extracting the substrate from the
5 interior of the selected processing island and positioning the substrate on the
6 conveyor.

- 1 20. The apparatus of claim 19, wherein the end effector has the shape of a fork.
- 1 21. The apparatus of claim 15, wherein the flow path is a continuous loop.
- 1 22. The apparatus of claim 15, wherein the conveyor has a plurality of individual holding
2 elements, each for holding a substrate.
- 1 23. The apparatus of claim 22, wherein the pitch between adjacent individual holding
2 elements and the pitch between adjacent chambers in a processing island is
3 substantially uniform.
- 1 24. The apparatus of claim 23, wherein the pitch between adjacent individual holding
2 elements is substantially equal to the pitch between adjacent chambers in each of said
3 plurality of processing islands.
- 1 25. The apparatus of claim 23, wherein the pitch between adjacent individual holding
2 elements is substantially equal to the pitch between adjacent chambers in at least one
3 of said plurality of processing islands.
- 1 26. The apparatus of claim 22, wherein each holding element is formed as a pallet
2 configured to centrally support a substrate, and the substrate exchange apparatus
3 includes at least one frame for supporting the substrate about a perimeter thereof, the
4 frame configured to be moved from a first position below the pallet to a second
5 position above the pallet for acquiring the substrate from the pallet, the frame having
6 a perimeter gap to permit passage of a pallet support element during exchange of the
7 substrate between the pallet and the frame.
- 1 27. The apparatus of claim 22, wherein each holding element has a C-shaped structure
2 with a first substrate holding moiety forming a top of the C-shaped structure.

- 1 28. An apparatus for performing thin film processing on substrates, comprising:
2 at least one processing islands, each processing island having:
3 an exterior,
4 an interior, and
5 at least one valve for exchange of a selected one of the substrates
6 between the exterior and the interior;
7 a substrate delivery and removal system; and
8 a substrate exchange apparatus for retrieving the selected one of the substrates
9 from the substrate delivery and removal system, introducing the selected one of the
10 substrates into the interior of a processing island, extracting the selected one of the
11 substrates from the processing island, and returning the selected one of the substrates
12 to the delivery and removal system;
13 wherein the substrate exchange apparatus is moveable between a first position
14 for retrieving the selected one of the substrates from the delivery and removal system,
15 and a second position for returning the selected one of the substrates to the delivery
16 and removal system.
- 1 29. The apparatus of claim 28, wherein said processing island is an inspection station for
2 inspection of the selected one of the substrates.
- 1 30. The apparatus of claim 28, further comprising a track extending between at least the
2 first position and a second position for returning the selected one of the substrates to
3 the delivery and removal system, the track passing adjacent to each of said processing
4 islands, the substrate exchange apparatus moveable along the track between the first
5 position and the second position.
- 1 31. The apparatus of claim 30, wherein the track has a first terminus at the first position
2 and a second terminus at the second position.
- 1 32. The apparatus of claim 30, wherein the track has a first side and a second side, and
2 the processing islands lie along the first and second sides of the track.

1 33. The apparatus of claim 28, wherein the substrate delivery and removal system
2 includes:

3 a plurality of cassettes each to hold a plurality of substrates; and
4 a cassette loading system for positioning the substrates to be retrieved by the
5 substrate exchange apparatus.

1 34. The apparatus of claim 28, wherein the substrate delivery and removal system
2 includes a conveyor for supporting the selected ones of substrates along a flow path,
3 the conveyor having a plurality of substrate holding elements.

1 35. The apparatus of claim 28, wherein each of said plurality of processing islands
2 includes:
3 a first load lock chamber having a first valve for introduction of the selected
4 one of the substrates therein; and
5 at least one processing chamber;
6 wherein for each processing island, said substrate exchange apparatus may be
7 moved to at least one exchange position, including an insertion position for
8 introducing the selected one of the substrates into the first load lock chamber.

1 36. The apparatus of claim 35, wherein said processing chamber includes one or more
2 chambers configured to perform at least one of a CVD process, a PECVD process, an
3 etching process, a cleaning process, a descumming process, a PVD process, a post-
4 anneal process, or a combination thereof.

1 37. The apparatus of claim 35, wherein the substrate exchange apparatus is moveable
2 along the track to a service position wherein the substrate exchange apparatus is
3 accessible for maintenance or replacement, which service position is located beyond
4 all of said at least one exchange positions.

1 38. An apparatus for performing thin film processing on substrates, comprising:
2 a substrate delivery and removal system;
3 a processing island having:
4 a first load lock chamber having a first valve for introduction of
5 substrates into the first load lock chamber;
6 at least one processing chamber; and
7 a second load lock chamber having a second valve for extraction of
8 substrates from the second load lock chamber;
9 a substrate exchange apparatus for retrieving substrates from the delivery and
10 removal system, introducing substrates into the first load lock chamber, extracting
11 substrates from the second load lock chamber, and returning substrates to the delivery
12 and removal system, the substrate exchange apparatus moveable between:
13 a first position for retrieving substrates from the delivery and removal
14 system;
15 an introduction position, remote of the first position, for introducing
16 substrates into the interior of the first load lock chamber; and
17 an extraction position, remote of said first position and said
18 introduction position, for extracting substrates from the second load lock
19 chamber.

1 39. The apparatus of claim 38, further comprising a track extending among at least the
2 first position, the introduction position and the extraction position, and passing
3 adjacent to said processing island, the substrate exchange apparatus moveable along
4 the track.

1 40. An apparatus for performing thin film processing on substrates, comprising:
2 first and second conveyors for supporting substrates as they move in
3 respective first and second flow paths;
4 a plurality of processing islands associated with the first and second flow
5 paths and each processing island including:
6 an exterior,

7 an interior, and
8 at least one valve for exchange of substrates between the exterior and
9 the interior;
10 an apparatus associated with each processing island for retrieving substrates
11 from the conveyor, introducing substrates to the interior of the processing island,
12 extracting substrates from the processing island, and transferring substrates to the
13 conveyor; and
14 at least one bypass robot for acquiring substrates from a first location along
15 the first flow path and transferring substrates to a second location along the second
16 flow path.

1 41. The apparatus of claim 40, wherein the bypass robot includes:

2 an end effector for engaging substrates;
3 a first actuator for vertically translating the end effector;
4 a second actuator for rotating the end effector about a vertical axis; and
5 a third actuator for horizontally translating the end effector.

1 42. An apparatus for performing thin film processing on substrates, comprising:

2 a plurality of processing islands, each processing island including:
3 an exterior,
4 an interior, and
5 at least one valve for exchange of a selected one of the substrates
6 between the exterior and the interior;
7 a substrate delivery and removal system;
8 a substrate exchange apparatus for retrieving the substrates from the substrate
9 delivery and removal system, introducing the substrates into the interior of a
10 processing island, extracting the substrates from the processing island, and returning
11 the selected one of the substrates to the delivery and removal system; and
12 at least one substrate buffer chamber to store the substrates prior to or after
13 processing.

1 43. An apparatus for performing thin film processing on substrates, comprising:
2 a plurality of processing islands, each processing island including:
3 an exterior,
4 an interior, and
5 at least one valve for exchange substrates between the exterior and the
6 interior;
7 a substrate delivery and removal system including a track passing adjacent to
8 each of said processing islands;
9 a substrate exchange apparatus for retrieving substrates from the substrate
10 delivery and removal system, introducing substrates into the interior of a processing
11 island, extracting substrates from the processing island, and returning substrates to
12 the delivery and removal system, the substrate exchange apparatus moveable along
13 the track, and wherein the track includes at least two modular tracks with conjunctible
14 interfaces, such that the track may be configured or extended by combining a
15 plurality of said modular tracks.

1 44. An apparatus for performing a process on a substrate, comprising:
2 a conveyor for supporting a substrate as it moves along a flow path;
3 a plurality of processing islands located adjacent to said flow path, each
4 processing island including a load lock heating chamber through which a substrate
5 may be introduced into said processing island and in which a substrate can be heated,
6 a processing chamber in which a process may be performed on the substrate after it is
7 heated, and a load lock cooling chamber in which the substrate may be cooled after it
8 has been subjected to the process in said processing chamber; and
9 a substrate transfer mechanism configured and arranged to transfer the
10 substrate between said conveyor and selected ones of said processing islands.

1 45. An apparatus for performing a process on a number of substrates, comprising:
2 a conveyor to support the number of substrates along a work flow path;
3 a plurality of substrate transfer mechanisms configured and arranged to
4 remove the substrates from and place the substrates on said conveyor; and

a plurality of processing islands located along said flow path, at least one of said plurality of processing islands having at least two chambers and further having a valve for introduction and extraction of one of the number of substrates into and out of an interior thereof, and such that the pitch between adjacent substrates on the conveyor and the pitch between adjacent chambers in said at least one processing island is substantially uniform.

46. A method for processing a plurality of substrates, comprising the steps of:

- (a) positioning one of a plurality of substrates onto a conveyor;
- (b) moving the substrate on said conveyor to a position adjacent a processing island having a first load lock and a second load lock;
- (c) removing the substrate from the conveyor;
- (d) introducing the substrate into the first load lock;
- (e) moving the substrate from the first load lock into a processing chamber;
- (f) processing the substrate in said processing chamber;
- (g) moving the substrate into the second load lock;
- (h) extracting the substrate from the second load lock and placing it on said conveyor; and
- (i) during the time of the steps (a)-(h), positioning at least one other substrate onto said conveyor.